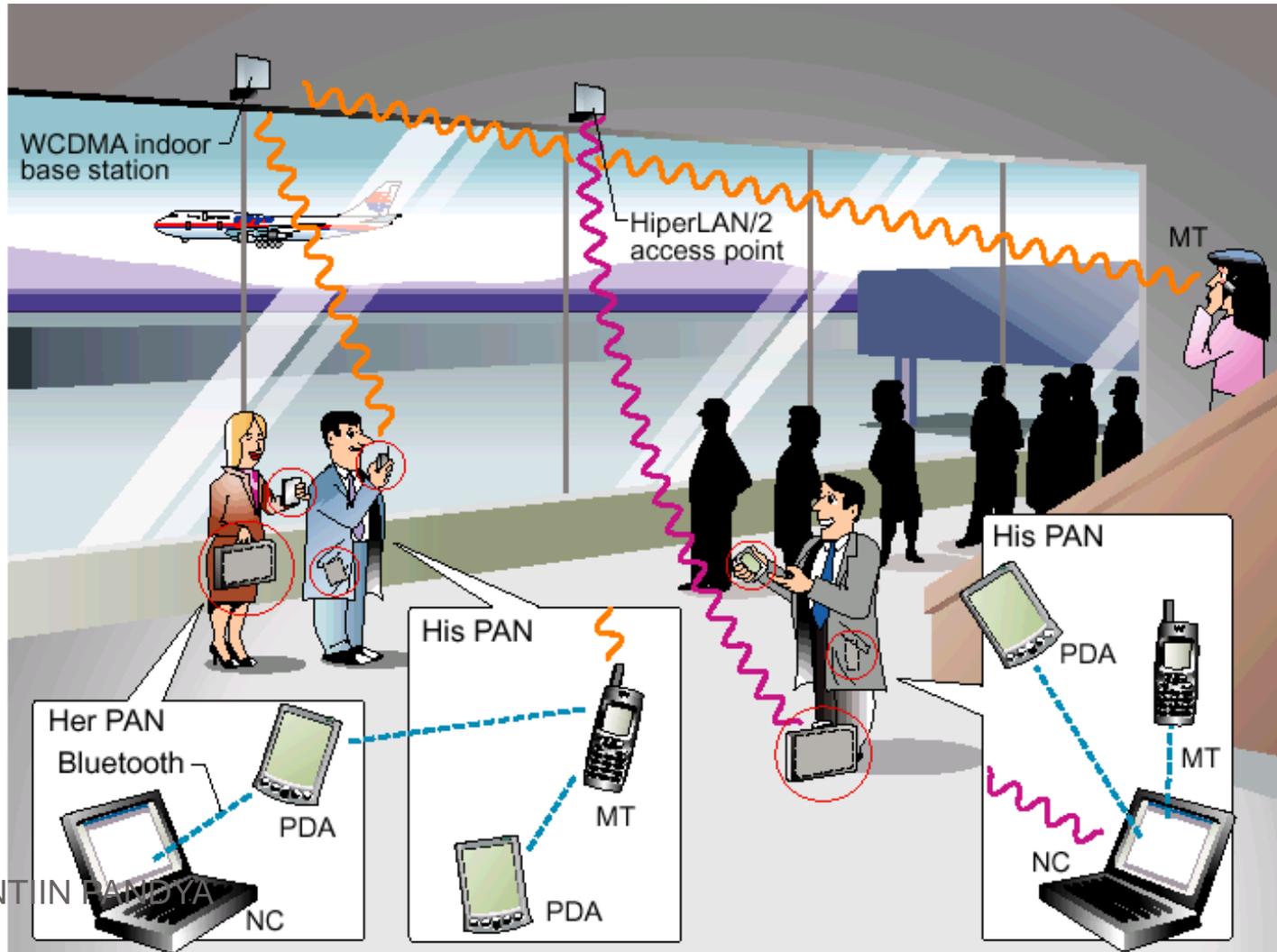


Mobile Computing Introduction

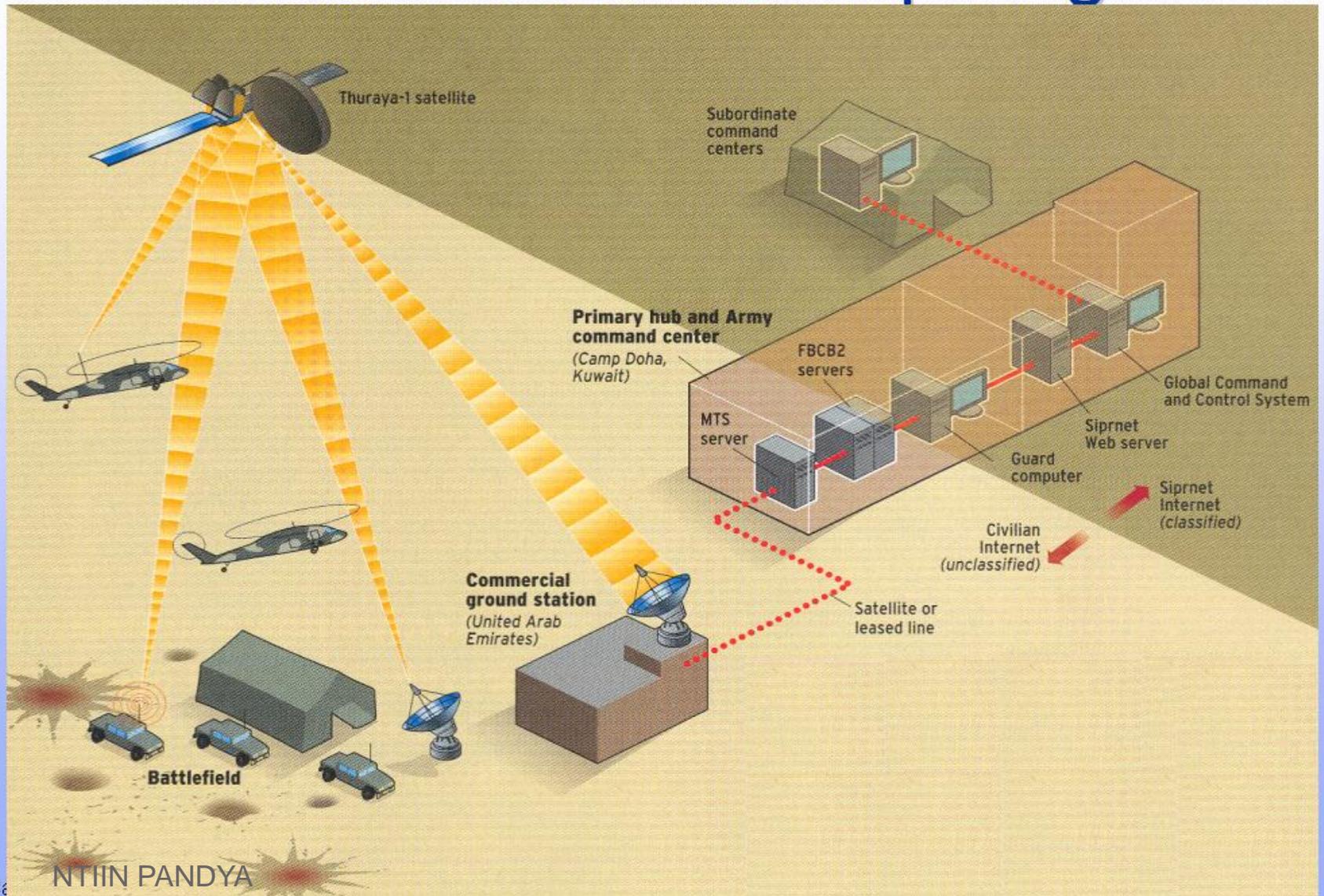
UNIT - 1

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What is Mobile Computing



What is Mobile Computing



Definitions – Mobile Computing

- What is **mobile computing**?
 - Computing that is not obstructed while the location of it changes

Mobile computing = +  

- Mobile computing draws from
 - Wireless communications and networking
 - Ability to communicate via wireless links
 - Ubiquitous and pervasive computing
 - Ability to provide computing anywhere and anytime (ubiquitous), usually in a seamless manner, potentially not perceived (pervasive)

Introduction

- **Mobile computing** is a form of human–computer interaction by which a computer is expected to be transported during normal usage.
- Mobile computing has three aspects:
 1. mobile communication
 2. mobile hardware
 3. mobile software

Mobile communication

- The first aspect addresses communication issues in ad-hoc and infrastructure networks as well as communication properties, protocols etc

Mobile hardware

- The second aspect is on the hardware, e.g., mobile devices or device components.

Mobile software

- The third aspect deals with the characteristics and requirements of mobile applications.

How wireless Network works



Characteristics of Mobile Computing

- **Fixed and wired:**

Typical LAN

- **Mobile and wired:**

Wi-Fi

- **Fixed and wireless:**

This mode is used for installing networks, e.g., in historical buildings to avoid damage by installing wires, or at trade shows to ensure fast network setup.

- **Mobile and wireless:**

GSM and Wi Max

APPLICATIONS OF MOBILE COMPUTING

Vehicles:

- Music, news, road conditions, weather reports, and other broadcast information are received via digital audio broadcasting (DAB) with 1.5 Mbit/s.
- For personal communication, a universal mobile telecommunications system (UMTS) phone might be available offering voice and data connectivity with 384 kbit/s.
- The current position of the car is determined via the global positioning system (GPS).

- Cars driving in the same area build a local ad-hoc network for the fast exchange of information in emergency situations or to help each other keep a safe distance.
- In case of an accident, not only will the airbag be triggered, but the police and ambulance service will be informed via an emergency call to a service provider.

Emergencies:

- An ambulance with a high-quality wireless connection to a hospital can carry vital information about injured persons to the hospital from the scene of the accident.
- Wireless networks are the only means of communication in the case of natural disasters such as hurricanes or earthquakes.
- In the worst cases, only decentralized, wireless ad-hoc networks survive.

Credit Card Verification:

- At Point of Sale (POS) terminals in shops and supermarkets, when customers use credit cards for transactions, the intercommunication required between the bank central computer and the POS terminal, in order to effect verification of the card usage, can take place quickly and securely over cellular channels using a mobile computer unit.
- This can speed up the transaction process and relieve congestion at the POS terminals.

- **Replacement of Wired Networks:** wireless networks can also be used to replace wired networks, e.g., remote sensors, for tradeshows, or in historic buildings.
- Due to economic reasons, it is often impossible to wire remote sensors for weather forecasts, earthquake detection, or to provide environmental information.

Infotainment:

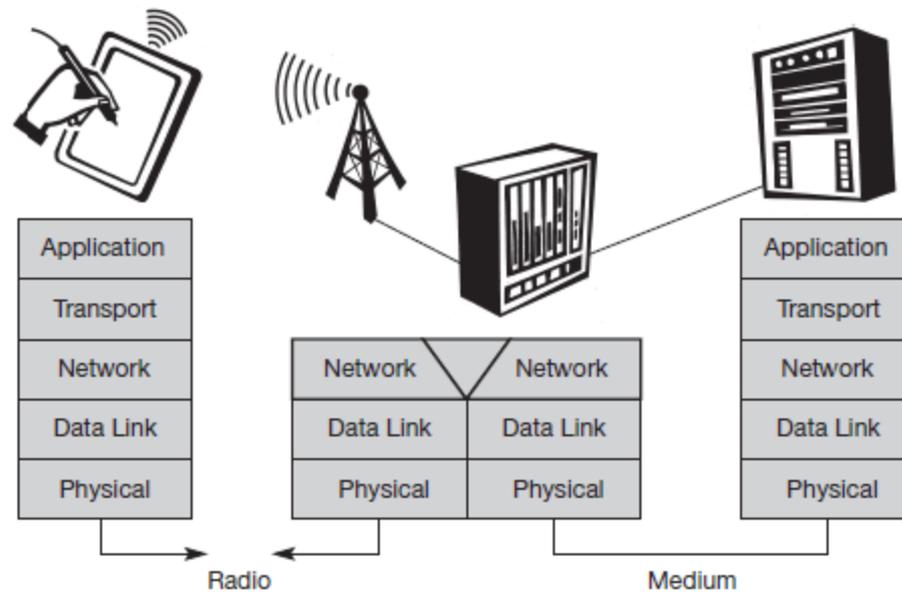
- wireless networks can provide up-to-date information at any appropriate location.
- Another growing field of wireless network applications lies in entertainment and games to enable, e.g., ad-hoc gaming networks as soon as people meet to play together.

Limitations of Mobile Computing

- **Resource constraints:** Battery
- **Interference:** Radio transmission cannot be protected against interference using shielding and result in higher loss rates for transmitted data or higher bit error rates respectively
- **Bandwidth:** Although they are continuously increasing, transmission rates are still very low for wireless devices compared to desktop systems. Researchers look for more efficient communication protocols with low overhead.
- **Dynamic changes** in communication environment: variations in signal power within a region, thus link delays and connection losses

- **Security constraints:** Not only can portable devices be stolen more easily, but the radio interface is also prone to the dangers of eavesdropping. Wireless access must always include encryption, authentication, and other security mechanisms that must be efficient and simple to use.
- **Network Issues:** discovery of the connection-service to destination and connection stability
- **Interoperability issues:** the varying protocol standards

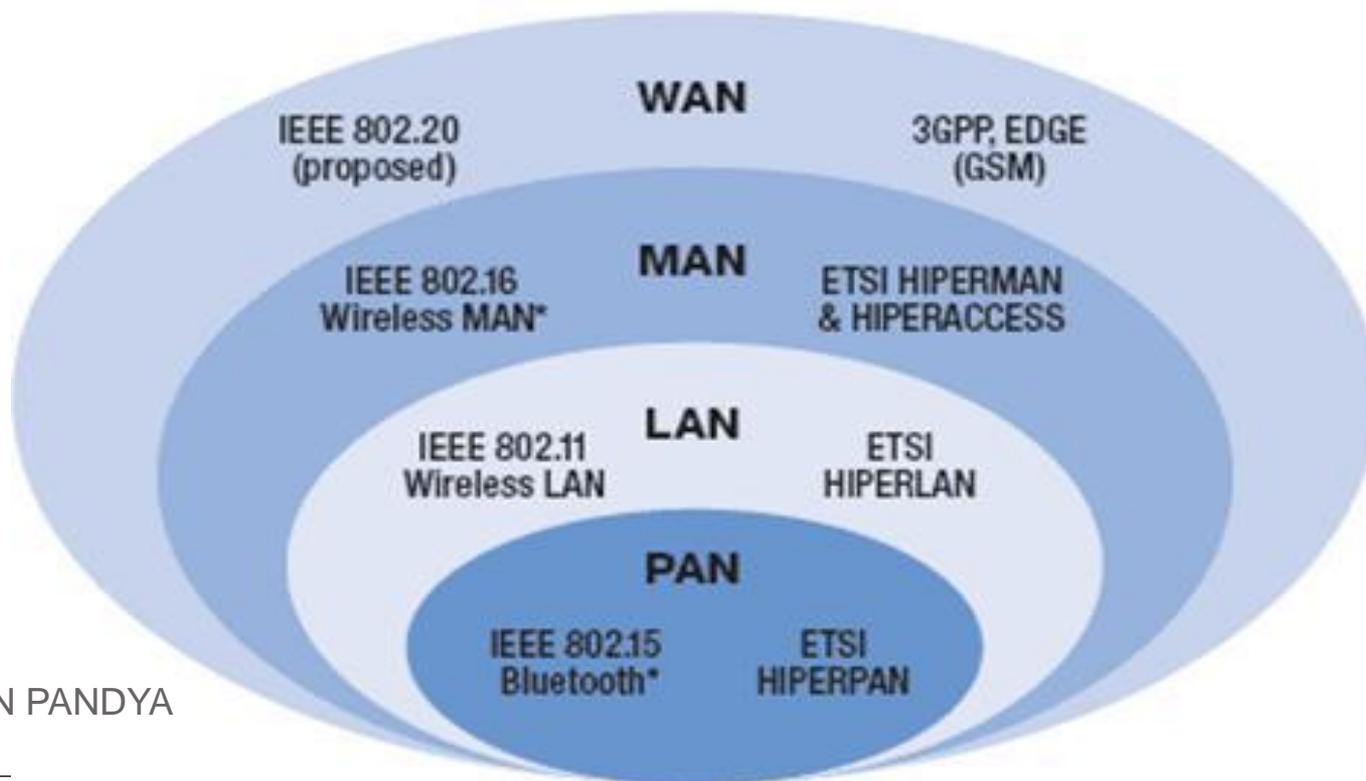
A simplified reference model



Wireless Standards

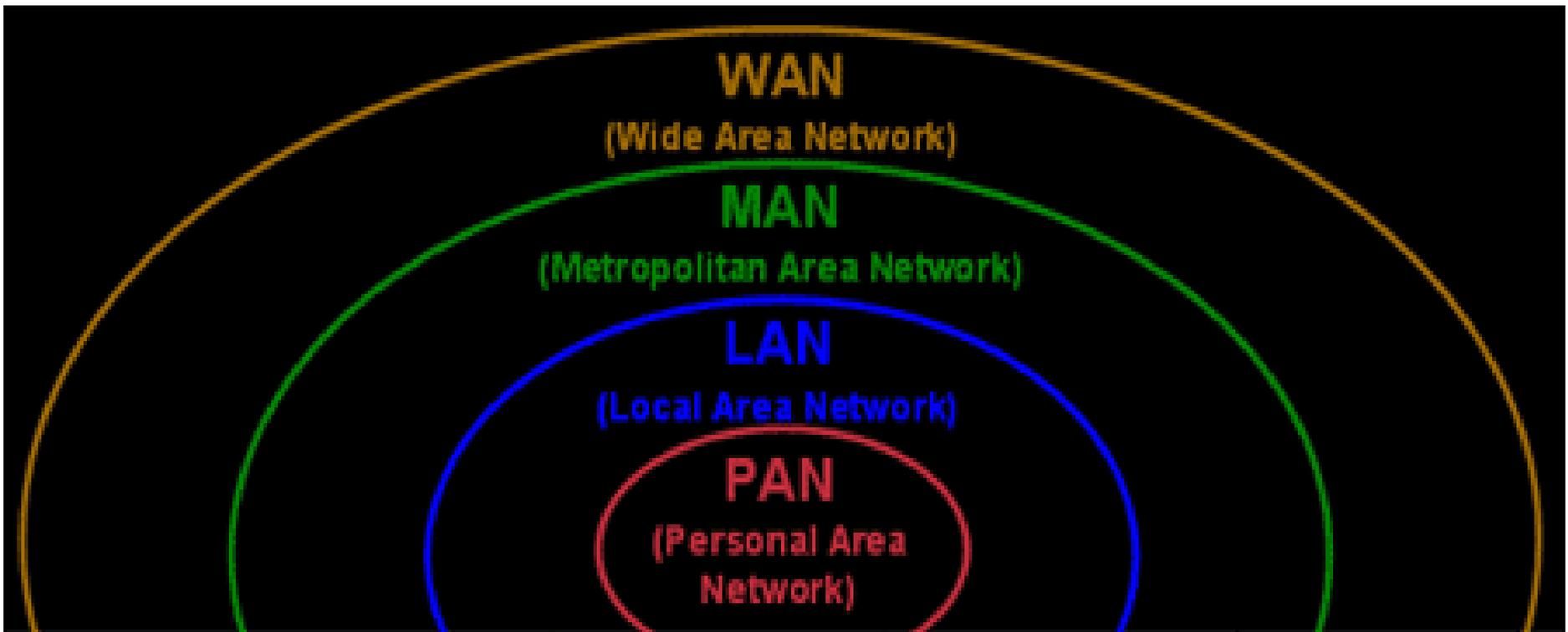
- Different methods and standards of wireless communication have developed across the world, based on various commercially driven requirements.

Global Wireless Standards



The table below summarizes the different 802.11 standards:

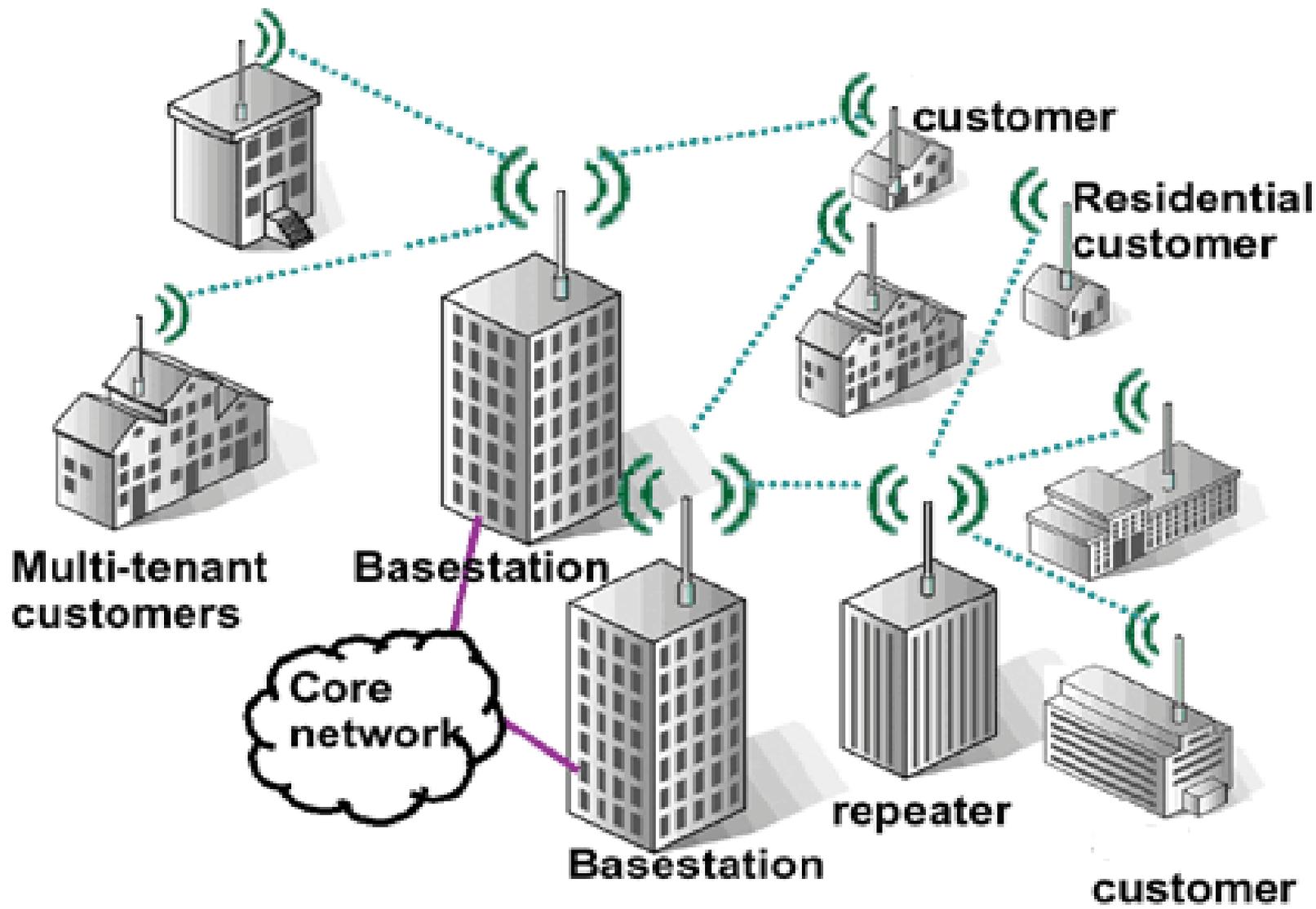
Protocol	Release Date	Op. Frequency	Data Rate (Typical)	Data Rate (Max)	Range (Indoor)
Legacy	1997	2.4 -2.5 GHz	1 Mbit/s	2 Mbit/s	?
802.11a	1999	5.15-5.35/5.47-5.725/5.725-5.875 GHz	25 Mbit/s	54 Mbit/s	~30 meters (~100 feet)
802.11b	1999	2.4-2.5 GHz	6.5 Mbit/s	11 Mbit/s	~50 meters (~150 feet)
802.11g	2003	2.4-2.5 GHz	11 Mbit/s	54 Mbit/s	~30 meters (~100 feet)
802.11n	2006 (draft)	2.4 GHz or 5 GHz bands	200 Mbit/s	540 Mbit/s	~50 meters (~160 feet)



	PAN	LAN	MAN	WAN
Standards	Bluetooth	802.11 HiperLAN2	802.11 MMDS, LMDS WIMAX (802.16)	GSM, GPRS, CDMA, HSDPA 2.5-3G-3.5G
Speed	< 1Mbps	11 to 54 Mbps	11 to 100+ Mbps	10 to 384Kbps 1.8/3.6 – 7.2Mbps
Range	Short	Medium	Medium-Long	Long
Applications	Peer-to-Peer Device-to-Device	Enterprise networks	E1 replacement, last mile access	Mobile Phones, cellular data

Metropolitan Area Network (MAN)

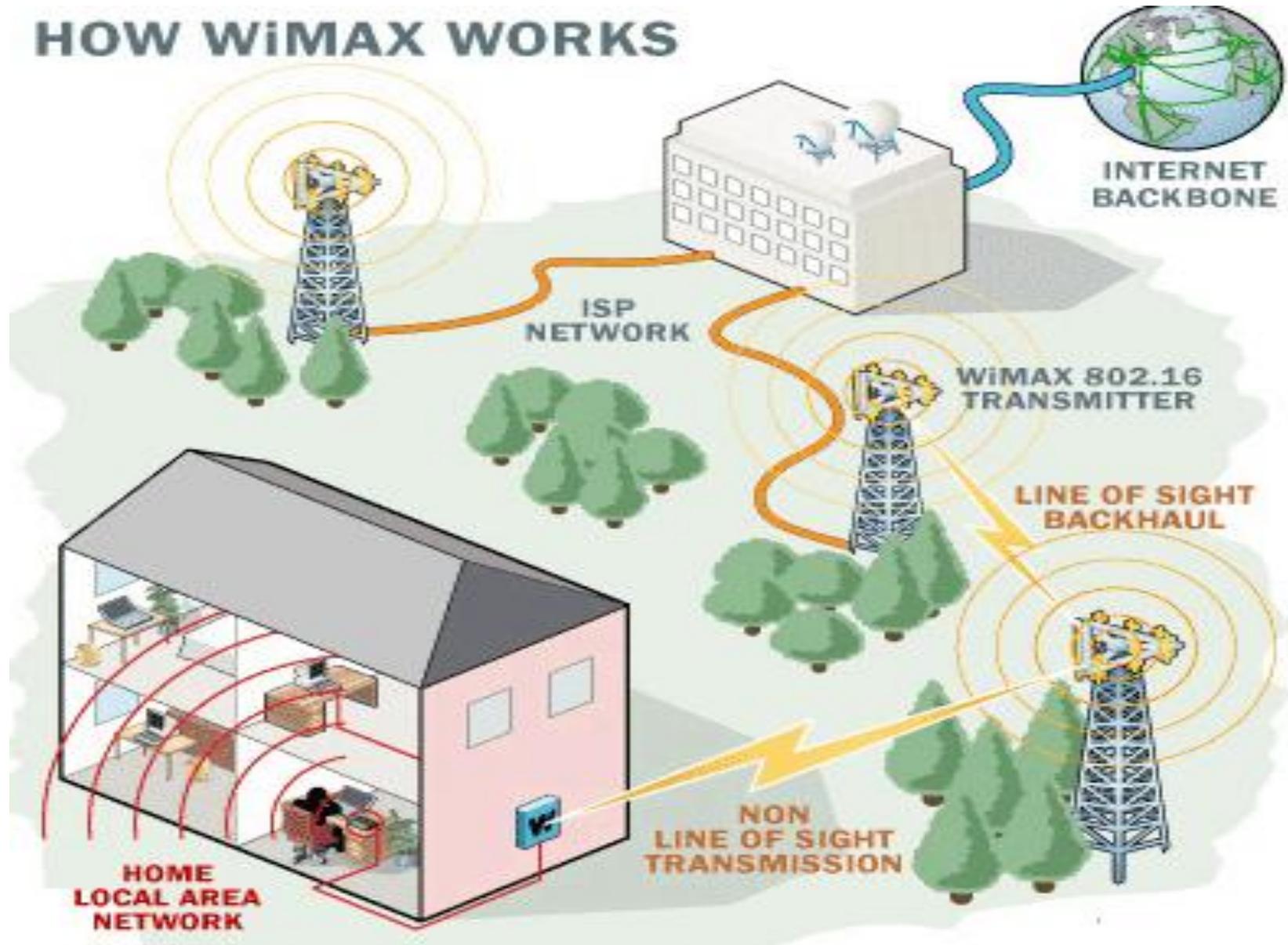
- Wireless Metropolitan Area Network (MAN) is the name trademarked by the IEEE 802.16 Working Group on Broadband Wireless Access Standards for its wireless metropolitan area network standard (commercially known as WiMAX), which defines broadband Internet access from fixed or mobile devices via antennas.



WiMAX:

- WiMAX is defined as Worldwide Interoperability for Microwave Access by the WiMAX Forum, formed in June 2001 to promote conformance and interoperability of the IEEE 802.16 standard, officially known as WirelessMAN.
- The Forum describes WiMAX as "a standards-based technology enabling the delivery of last mile wireless broadband access as an alternative to cable and DSL".

HOW WiMAX WORKS



Evolution of Mobile Computing

- **Mobility and agility**
- **Identity authentication**
- **Pervasive identity data**
- **Intelligent Data Services**
- **Games and the 'intelligent home'**

Compare AOC and SOC Client

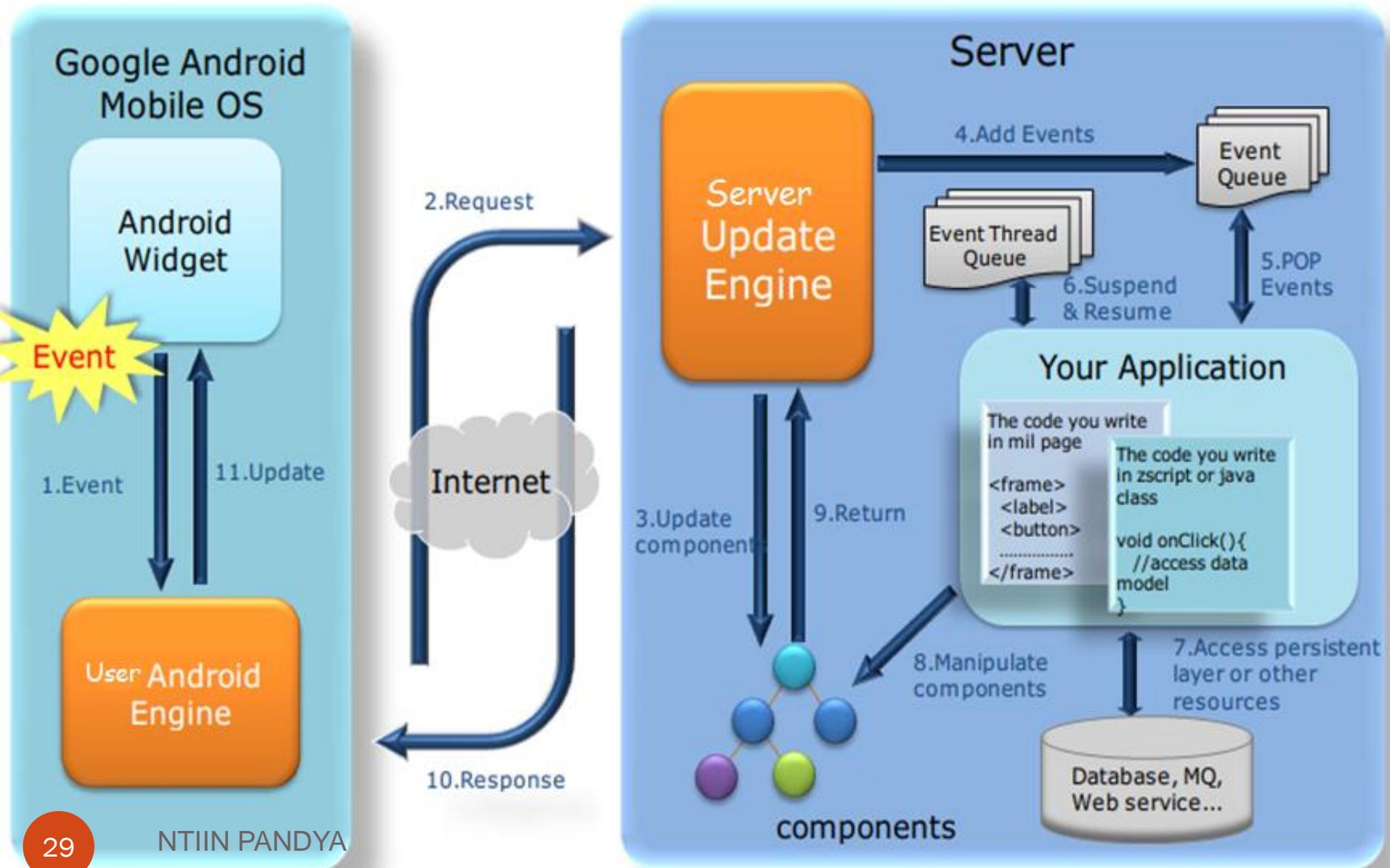
Mobile technology can be implemented with :

- Sometimes On Connectivity (SOC) to mobile devices
- Always On Connectivity (AOC).

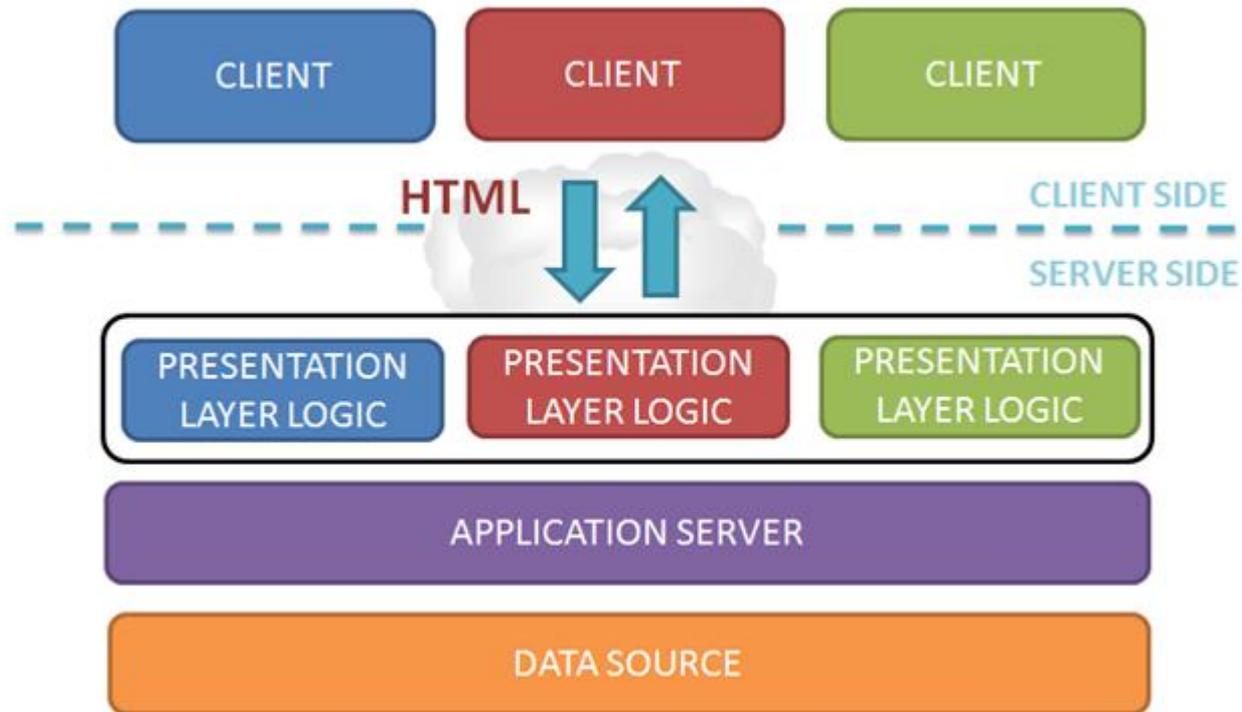
- BSI Consulting coined SOC and AOC terminology in order to effectively describe to our clients the communications frequency and performance: capabilities of alternatives for mobile computing solutions.
- SOC clients can work effectively in a disconnected mode and take advantage of wireless or wired connections when they are available while AOC clients must be connected all or most of the time to be effective.
- SOC client technology typically requires a Pocket PC or WinCE device in order to have sufficient processing power and data storage capability

- SOC clients have the ability to store large amounts of data on the mobile device and provide the user with a complete application solution even when the user does not have a wireless or wired data connection.
- Data updates can occur when wireless, Internet dialup, network or desktop synchronization connections are available. Regardless of connectivity, productive work can proceed.
- Data updates, when they do occur, can be fast bursts of small amounts of data rather than entire screen images that AOC clients employ..

Mobile computing OS



THREE TIER MOBILE COMPUTING ARCHITECTURE



Presentation tier

- This is the topmost level of the application. The presentation tier displays information related to such services as browsing merchandise, purchasing, and shopping cart contents. It communicates with other tiers by outputting results to the browser/client tier and all other tiers in the network.

Application tier (business logic, logic tier, data access tier, or middle tier)

- The logic tier controls an application's functionality by performing detailed processing.

Data tier

- This tier consists of database servers. Here information is stored and retrieved. This tier keeps data neutral and independent from application servers or business logic. Giving data on its own tier also improves scalability and performance.

Design considerations for mobile computing

- The mobile computing environment needs to be context independent as well as context sensitive. Context information is related to the environment.
- The term context means all the information that helps to determine the state of the object.
- In a mobile computing environment the context data is captured so that decisions can be made about how to adapt content or behavior to suit this context.

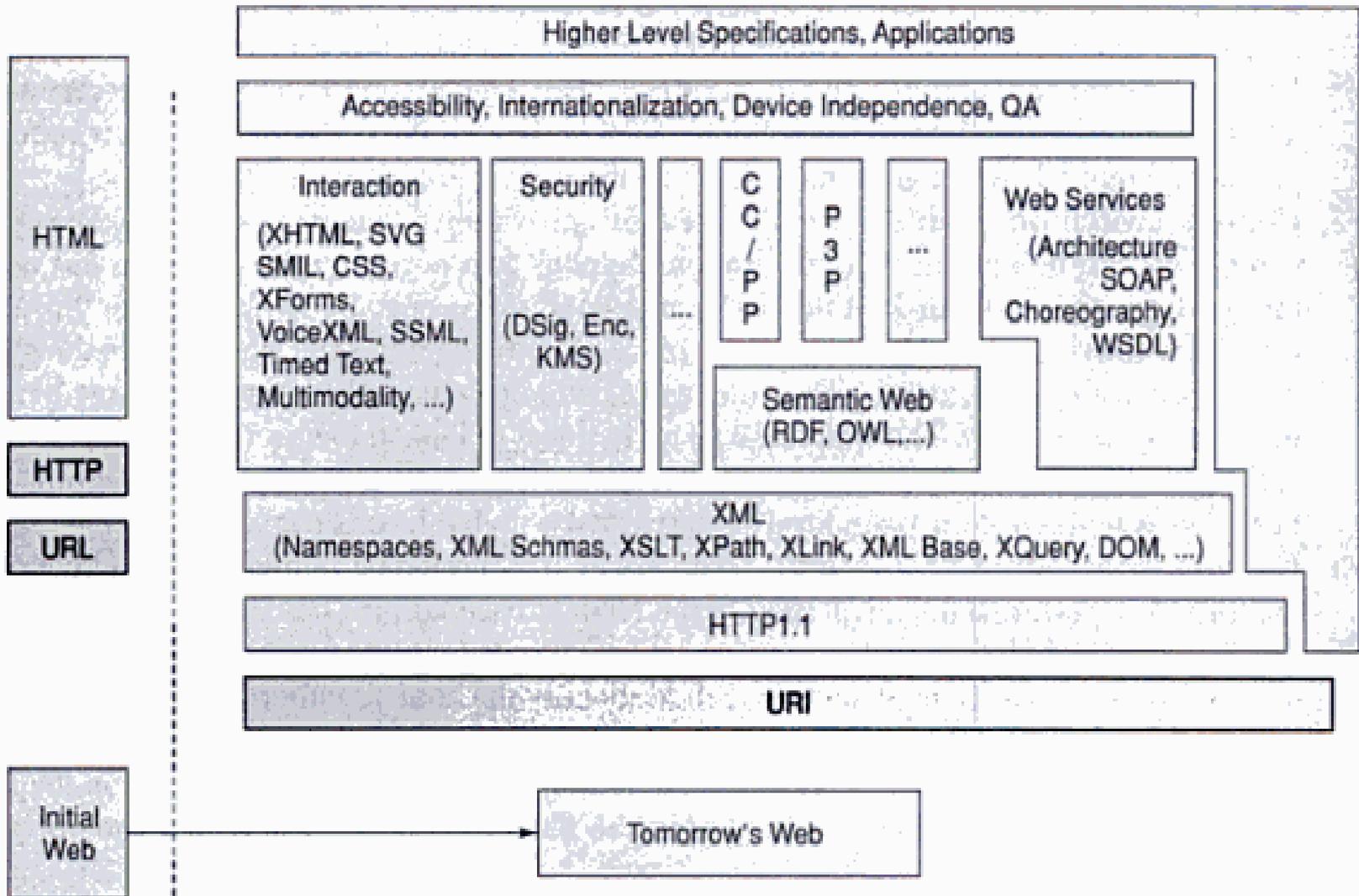
Design considerations for mobile computing

- **Client context Manager**

We need a client context manager to gather & maintain information pertaining to the client device, user, network and the surrounding environment.

Mobile computing applications are needs to operate in dynamic conditions which is due to different network conditions.

- Most applications developed for Web access by keeping large screen and browser in mind.
- So therefore a context manager is need to maintain the information pertaining to the client device (ie mobile phone)



The Content Architecture with Respect to **Mobile Computing**

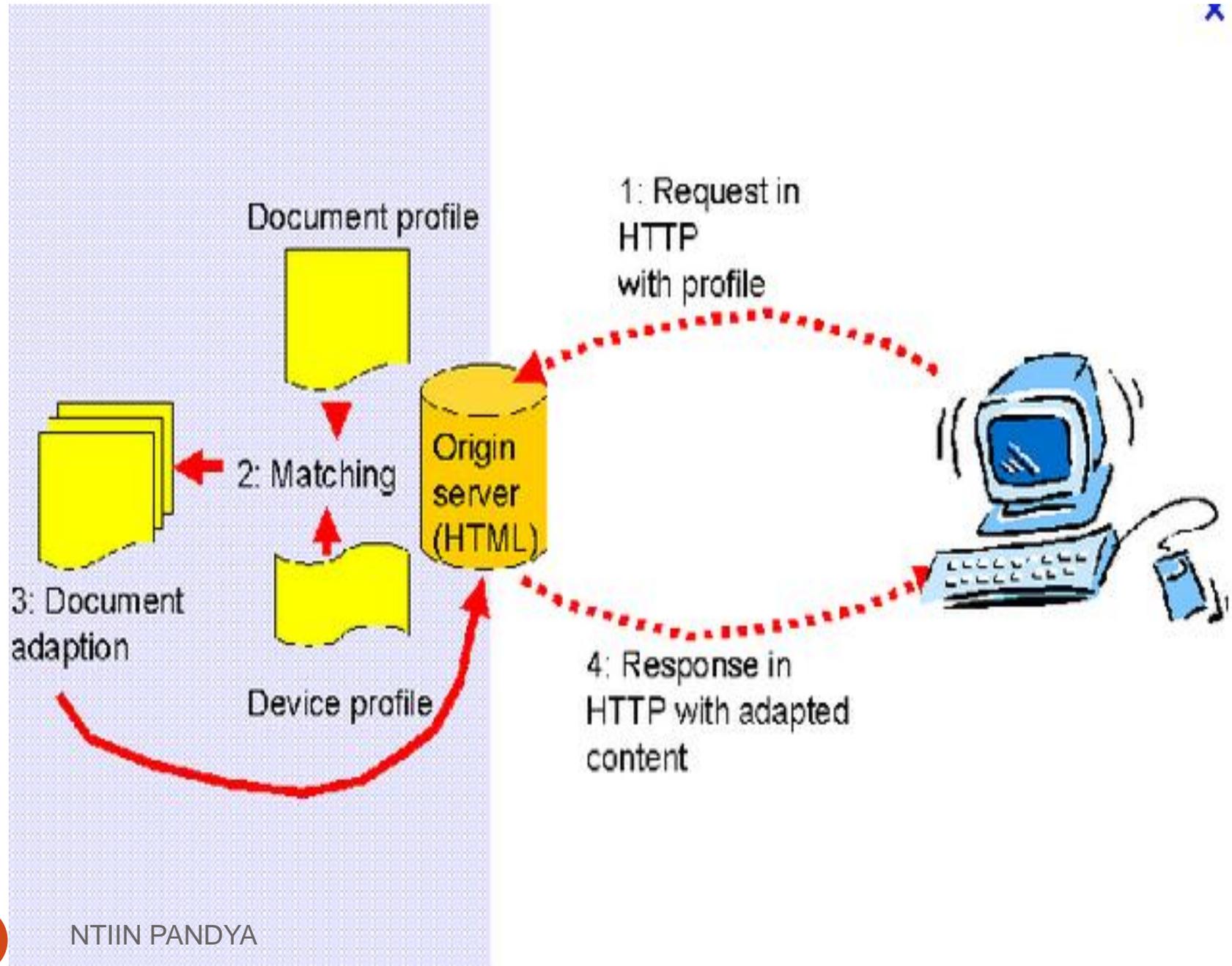
Examples of context information

1. **Identity:** The device will be in a position to communicate its identity without any ambiguity.
2. **Spatial information:** Information related to the surrounding space. This relates to location, orientation, speed, elevation and acceleration.
3. **Temporal information:** Information related to time. This will be time of the day, date, time zone and season of the year.
4. **Environmental information:** This is related to the environmental surroundings. This will include temperature, air quality, moisture, wind speed, natural light or noise level. This also includes information related to the network and network capabilities.
5. **Social situation:** Information related to the social environment. This will include who you are with, and people that are nearby; whether the user is in a meeting or in a party.

6. **Resources that are nearby:** This will relate to the other accessible resources in the nearby surroundings like accessible devices, hosts or other information sinks.
7. **Availability of resources:** This will relate to information about the device in use. This will include battery power, processing power, persistence store, display, capabilities related to I/O (input/output) and bandwidth.
8. **Physiological measurements:** This relates to the physiological state of the user. This includes information like blood pressure, heart rate, respiration rate, muscle activity and tone of voice.
9. **Activity:** This relates to the activity state of the user. This includes information like talking, reading, walking and running.
10. **Schedules and agendas:** This relates to the schedules and agendas of the user.

Composite capabilities/preference profiles

- A CC/PP profile is a description of device capabilities and user preferences. This is often referred to as a device's delivery context and can be used to guide the adaptation of content presented to that device.



- *The CC/PP is designed in such a way that an origin or proxy server can perform some sort of content to device matching.*
 - a. Device sends serialized profile with request for content.
 - b. Origin server received Resource Description Framework (RDF) & convert it into a memory model.
 - c. Document is retrieved as per request.
 - d. Representation of doc is chosen.
 - e. Document is presented to device.

Policy manager :

- The role of policy manager is to create a set of rules needed to be followed under different conditions.

Semantic Web :

- The **Semantic Web** is a collaborative movement led by the World Wide Web Consortium (W3C) that promotes common formats for data on the World Wide Web.
- By encouraging the inclusion of semantic content in web pages, the Semantic Web aims at converting the current web of unstructured into a "web of data". It builds on the W3C's **Resource Description Framework(RDF)**.

Security Manager :

Provides secure connection between client device and a server. It includes :

- a. *Confidentiality*
- b. *Integrity*
- c. *Availability*
- d. *Non-repudiation – identification of user*
- e. *Trust*

Platform for privacy preference project(P3P)

- The Platform for Privacy Preferences Project (P3P) enables Websites to express their privacy practices in a standard format that can be retrieved automatically and interpreted easily by user agents.
- P3P user agents will allow users to be informed of site practices (in both machine- and human-readable formats) and to automate decision-making based on these practices when appropriate. Thus users need not read the privacy policies at every site they visit. Have a look at the list of P3P software.

Adaptability Manager

- It is responsible for adapting content, behavior and other aspects according to context and policy.

Content adaptation and Transcoding

It checks :

- Physical capabilities of the device
- Logical capabilities of the device
- Network effect
- Payload

Content rating and Filtering

PICS(Platform for Internet Content Selection)

- *Digital signature*
- *Intellectual property rights management*
- *Privacy*
- *Personalization*

Content aggregation

- OEM(Original Equipment Manufacturer) creates content for their devices.

Seamless Communication

Collaboration with the GSM, CDMA etc which provide :

- Authentication
- Authorization
- Billing charges
- End to end data security
- Roaming
- Session migration
- IP mobility

Autonomous Computing

- Self configurable
- Self optimization
- Self healing
- Self protecting
- Self upgradable

Content Aware Systems

Description of information :

- Location information : include cell structure and cell ID.
- Device information : EIR(equipment identity register), IMEI number (International mobile equipment identity)
- Network information : GSM or GPRS
- User information : SIM
- Environment information : surroundings